UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/976,739	10/11/2001	Christopher L. Wooten	TT4314	2217

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THE CAVANAGH LAW FIRM
VIAD CORPORATE CENTER
1850 NORTH CENTRAL AVENUE, SUITE 2400
PHOENIX, AZ 85004

EXAMINER
TUCKER, WESLEY J

ART UNIT	PAPER NUMBER
2623	

DATE MAILED: 06/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

	Office Action Summary	Application No.	Applicant(s)
		09/976,739	WOOTEN ET AL.
		Examiner	Art Unit
		Wes Tucker	2623

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>22 November 2004</u>.

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1-20</u> is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) <u>1-20</u> is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on <u>11 October 2001</u> is/are: a)☒ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
    Paper No(s)/Mail Date ~~11-26-04~~. 11/22/04

4) ☐ Interview Summary (PTO-413)
    Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment and Arguments

1.   Applicant's response to the last office action, filed November 22nd, 2004

has been entered and made of record.

2.   Applicant has amended claims 4, 5, 14, 15 and 20. Applicant has

canceled claim 16. Claims 1-20 are pending.

3.   Applicant's arguments have been fully considered and entered, but are not

fully persuasive for at least the following reasons:

Response to Arguments Regarding 112 Rejections

4.   Applicant has explained and amended where necessary the claims in

response to the 112 1st and 2nd paragraph rejections. The 112 rejections are withdrawn

in view of the explanations and amendments. However Examiner maintains that the

term uncategorized is fairly broad and non-descriptive and will therefore be interpreted

broadly.

Response to Arguments Regarding 102(e) Rejections

5.   Applicant argues that claims 1, 10 and 15 contain subject matter not

disclosed in the reference of Ferrell. However Examiner submits that Applicant simply

quotes Ferrell in pages 11-15 of the response and then states that Ferrell does not

disclose the features claimed in claims 1, 10 and 15. Examiner maintains that the

reference of Ferrell discloses the elements claimed as interpreted and previously

presented in the previous rejection. The rejection is therefore maintained and the action

is accordingly made final.

Response to Arguments Regarding 103 Rejections

6.   Applicant's statements about the 103 rejections are simply statements that

the 103 rejected claims depend on the claims rejected under 102. Examiner submits

that the rejections under 35 USC 102 still apply.

Reiections Under 35 U.S.C 102(e)

13. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102

that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under

section 122(b), by another filed in the United States before the Invention by the

applicant for patent or (2) a patent granted on an application for patent by another filed

in the United States before the invention by the applicant for patent, except that an

international application filed under the treaty defined in section 351(a) shall have the

effects for purposes of this subsection of an application filed in the United States only if

the international application designated the United States and was published under

Article 2142) of such treaty in the English language.

14. Claims 1-2, 10-12, and 15-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Farrell et al.

15. The following is in regard to Claim 1. Ferrell et al. disclose a method for performing defect spatial signature (numerical descriptors or feature vectors) - Farrell et al. column 2, lines 55-59, column 4, lines 64-67 and column 5, lines 6-9) analysis of a semiconductor process (Farrell et al. column 2, lines 8-33 and lines 36-41). The method of Farrell et al. comprises:

(1.a.) Creating a defect database of wafers having defect spatial signatures - for example, the Image Database 5 of Farrell et al. Fig.1 or the hierarchical search tree (Farrell column 3, lines 15-17). Note that the latter is a data structure that comprises searchable data arranged in a structured fashion and, in that respect, represents a database. The hierarchical search tree (HST) will be referred to interchangeably with defect database, henceforth in this document.

The defect spatial signatures in the defect database are uncategorized data in that:

1.They can correspond to unclassified defects (Farrell et al. column 13, lines 3-5).

2. Their arrangement in the HST is according to their relative similarity (Farrell et al. column 9, lines 48-56), as opposed to some defect classification schema.

(1.b.) Generating a recent defect spatial signature (e.g. steps 14-16 of Farrell et al. Fig. 3A). Though any of the stored feature vectors can be regarded as being recent

(since the term recent is highly relative), the query vector(s) (Farrell et al. column 3,

lines 39-41) will be assumed, herein, to represent the recent defect spatial signature. It

is, perhaps, most recent with respect to the stored feature vectors.

(1.c.) Determining if the recent defect spatial signature corresponds to at least

one of the defect spatial signatures of the defect database (Farrell et al. column 11,

lines 21-38).

It has thus been shown that the method of Farrell sufficiently conforms to the

method set forth in Claim 1.

16. The following is in regard to Claim 2. As shown above, the method of Farrell

et al. adequately satisfies the limitations of claim 1. Furthermore, the leaf nodes (e.g.

V1, V2, V3, ... of Farrell et al. Fig. 6) in the HST of Farrell et al.'s method each

encapsulate a feature vector (Farrell et al. column 3, line 19) and are added such that

the encapsulated feature vector is exclusive of the set of feature vectors present in the

HST (Farrell et al. column 3, lines 30-33). In addition, redundant nodes are purged from

the HST (Farrell et al. column 4, lines 15-17). As a result, one may conclude that the

defect database (HST) contains essentially uncorrelated data.

17. The following is in regard to Claim 10. Ferrell et al. disclose a method for

evaluating process anomalies (e.g. defects, represented by numerical descriptors or

feature vectors - Farrell et al. column 2, lines 55-59, column 3, lines 4-6, column 4, lines

64-67 and column 5, lines 6-9) in a semiconductor process (Farrell et al. column 2, lines

8-33 and lines 36-41). The method of Farrell et al. comprises:

(10.a.) Generating a database of process anomalies - for example, the Image

Database 5 of Farrell et al. Fig.1 or the hierarchical search tree (Farrell column 3, lines

15-17). Each of the feature vectors (or images of the Image Database 5 - Farrell et al.

column 4, lines 54-56 and column 6, lines 6-9) represents or corresponds to an

anomaly. As shown above, with respect to claim 2, these feature vectors, and hence the

associated anomalies, are uncorrelated. Please refer to the discussion above.

(10.b.) Inspecting a wafer having at least one process anomaly (e.g. capturing an

image of a wafer - Farrell et al. Fig. 3A, column 4, lines 59-67 and column 5, lines 6-9).

(10.c.) Determining if the at least one process anomaly corresponds to a process

anomaly in the database of process anomalies (Farrell et al. column 11, lines 21-38).

It has thus been shown that the method of Farrell sufficiently conforms to the method

set forth in Claim 10.

18. The following is in regard to Claim 12. As shown above, the method of Farrell

et al. adequately satisfies the limitations of claim 10. Following the discussions above

with regard to claims 1 and 10, it should be clear that the anomalies (as represented by

the aforementioned feature vectors) are uncategorized.

19. The following is in regard to Claim 15. Ferrell et al. disclose a method for

determining the occurrence of an anomalous event (e.g. a defect or anomaly – see

above and Farrell et al. column 2, line 65 and column 8, lines 13-30). The method

comprises:

(15.a.) Storing a plurality of defect maps (i.e. defect masks - Farrell et al. column

8, lines 16-18) in a storage device. These masks (presumably stored) are used to

develop each feature vector in step 16 of Farrell et al. Fig. 3A (Farrell et al. column 9,

lines 7-9), associated with the images stored in Image Database 5 of Farrell et al. Fig. 1

(Farrell et al. column 9, lines 20-21).

(15.b.) Creating a defect map (defect mask) of a recent anomalous event (e.g. a

defect). See Farrell et al. column 3, lines 39-41 and note that the query image

undergoes the same procedure as discussed above, wherein a defect mask is derived

from the query image and used to determine the associated feature vector (Farrell et al.

column 8, lines 13-30 and Fig. 3A).

(15.c.) Determining if the defect map of the recent anomalous event corresponds

to one of the plurality of defect maps in the storage device (Farrell et al. column 11,

lines 21-38).

It has thus been shown that the method of Farrell sufficiently conforms to the

method set forth in Claim 15.

20. The following is in regard to Claim 16. As shown above, the method of Farrell

et al. adequately satisfies the limitations of claim 15. It was shown above, with respect

to claims 1 and 2, that the feature vectors stored in the HST were essentially

uncorrelated and uncategorized. Given their direct association with these feature

vectors, the defect maps (defect masks) are, by implication, uncorrelated and

uncategorized.

Rejections Under 35 U.S.C. Q 103(a)

21. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed
>
> or described as set forth in section 102 of this title, if the differences between the
>
> subject matter sought to be patented and the prior ad are such that the subject
>
> matter as a whole would have been obvious at the time the invention was made
>
> to a person having ordinary skill in the art to which said subject matter pertains.
>
> Patentability shall not be negatived by the manner in which the invention was
>
> made.

22. Claims 3-5, 8, 13-14, and 18-20 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Farrell et al., in view of La et al. (U.S. Patent 5,761,064).

23. The following is in regard to Claim 3. As shown above, the method of Farrell

et al. adequately satisfies the limitations of claim 1. Farrell et al. do not expressly show

or suggest that the defect database (e.g. Image Database 5 of Farrell et al. Fig.1 or the

aforementioned hierarchical/ search free).

24. Relational databases have had a broad range of applications, in nearly every

conceivable industry, to various types and forms of data. It is no surprise, therefore, that

they have seen widespread application to the various data encountered in the

semiconductor industry. For example, La et al. disclose an automated defect

management system in which semiconductor wafer defect are collected from wafer

inspection instruments (La et al. Abstract). The wafer defect data, which includes spatial

information (e.g. reference numbers 144, 146, 148, 150, and 152 of La et al. Fig. 3), is

stored in a central database system consisting of a relational database (La et al. column

3, lines 51-53).

25. The teachings of La et al. and Farrell et al. are combinable because they are

analogous art - that is, each relate the field of defect detection and analysis and defect

information storage. Therefore, it would have been obvious to one of ordinary skill in the

art, at the time of the applicant's claimed invention, to use, as La et al. suggests, a

relational database for the storage of defect information, such as the feature vectors of

Farrell et al. The relational model used in relational database systems is particularly

advantageous over other database schema, because it requires few assumptions about

relationships between the disparate data contained in the database. This resolves much

of the data inconsistency and scalability issues that plague so-called flat-file databases.

26. The following is in regard to Claim 18. Claim 18 recites essentially the same limitations as claim 9. Therefore, with regard to claim 18, remarks analogous to those presented above relative to claim 9 are applicable.

27. The following is in regard to Claim 4. As shown above, the teachings of Farrell et al. can be combined with those of La et al. so as to adequately satisfy the limitations of claim 3. In addition, Farrell et al. further disclose storing coordinates (e.g. the centroid (X_c, Y_c) - Farrell et al. column 7, lines 23-28) of a process signature of a first defect (i.e. the feature vector, in the collection of feature constituting the vector list corresponding to, say, a "first" defect - Farrell et al. Fig. 3A) and storing coordinates of a process signature of a second defect (i.e. the feature vector, in the collection of feature constituting the vector list, corresponding to, say, a "second" defect - Farrell et al. Fig. 3A). For the centroid to be meaningful, its coordinates must be expressed relative to some fixed coordinate system, preferably scaled and stationed fixedly with respect to the image, or other measured representation, of the defect or wafer. In this manner, the coordinates of the process signatures of the first and second defects would be inherently in relation to each other.

28. The following is in regard to claim 19. Claim 19 recites essentially the same limitations as claim 3. Therefore, with regard to claim 19, remarks analogous to those presented above relative to claim 3 are applicable.

29. The following is in regard to Claim 8 and 13. As shown above, the method of

The following is in regard to Claim 19. Claim 19 recites essentially the same

Farrell et al. adequately satisfies the limitations of claim 1. Heeding the discussions

above with respect to claims 3 and 4, it should be clear that the method, obtained by

combining the teachings of Farrell et al. and La et al. in the manner proposed above,

would involve:

(8.a.) Creating a relational database of defects. Refer to the discussion above

relating to claim 3.

(8.b.) Storing coordinates of a process signature of a first defect and storing

coordinates of a process signature of a second defect, wherein the coordinates of the

process signatures of the first and second defects are relative to each other. Refer to

the discussion above relating to claim 4.

30. By adopting the same interpretation of process anomalies as used in claim

10 (i.e. that process anomalies are defects, represented by numerical descriptors or

feature vectors - Farrell et al. column 2, lines 55-59, column 3, lines 4-6, column 4, lines

64-67 and column 5, lines 6-9), it should be evident that previous discussion relating to

claim 8 sufficiently addresses the limitations set forth in claim 13.

31. The following is in regard to Claim 5. As shown above, the teachings of Farrell

et al. can be combined with those of La et al. so as to adequately satisfy the limitations

of claim 3. La et al. further suggest the inclusion of defect density in the wafer defect

data used for analysis (La et al. column 6, lines 49-50 and line 54). The defect density

is, at least, local to wafer under observation. Furthermore, since density, as a physical

measure, is inherently mathematical in nature (generally, a quantity (e.g. mass, number

of defects, etc.) divided by a unit spatial quantity (e.g. unit volume, unit area, unit length,

unit wafer surface-area, etc.), the defect density would necessarily be derived according

to a mathematical formulation.

32. The following is in regard to Claims 14 and 20. Claims 14 recites essentially

the same limitations as claim 5. Therefore, with regard to claims 14 and 20, remarks

analogous to those presented above relative to claim 5 are applicable.

33. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Farrell

et al. in view of Jain et al. (U.S. Patent 5,893,095).

34. The following is in regard to Claim 6. As shown above, the method of Farrell

et al. adequately satisfies the limitations of claim 1. Farrell et al., however, do not

expressly show or suggest adding the recent defect spatial signature (i.e. the query

vector) to the defect database.

35. Jain et al. disclose a method for content-based search and retrieval of stored

visual objects (e.g. imaged defects) based on similarity of content to a target (query)

visual object (Jain et al. Abstract and Field of Invention). Like Farrell et al.'s method, the

method of Jain et al. accepts a query image (Jain et al. column 4, lines 29-30 and Fig.

5A, steps 242 and/or 247), derives a feature vector (Jain et al. Fig. 5A, step 122 and

column 12, lines 26-38) corresponding to the visual attributes (i.e. primitives - Jain et al.

column 4. lines 2-8, column 6, lines 36-37, and column 8, lines 6-11) of the image, and

determines a set of feature vectors, stored in a database (e.g. database 132 or FVi

storage 264 of Jain et al. Fig. 5B), that are sufficiently similar (i.e. correspond to) the

input query vector (Jain et al. Fig. 5B). These feature vectors are analogous to the

defect natures discussed above. As suggested by Jain et al. (Jain et al. Fig. 5B, step

247, column 11, lines 60-65 and column 21, lines 30-38), the query feature vector (i.e.

the "recent" defect spatial signature - see above) may be added to the defect database.

36. The teachings of Jain et al. and Farrell et al. are combinable because they

are analogous art. The functional and structural similarities of the two disclosed

methods should be apparent. Moreover, Jain et al. suggests the application of their

system and method to defecting and analyzing defects in semiconductor wafers (Jain et

al. column 16, line 59 and 63-67 and column 4, line 67 to column 5, lines 1-3).

Therefore, given the teachings of Jain et al., it would have been obvious to one of

ordinary skill in the art, at the time of the applicant's claimed invention, to add the recent

defect spatial signature (i.e. the query vector) to the defect database. The motivation to

do so would have been to provide persistent availability (via the data persistence

offered by a database) to past defect queries.

37. Claims 7, 11, and 17 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Farrell et al., in view of Tobin et al. (U.S. Patent 6,535,776).

38. The following is in regard to Claim 7. As shown above, the method of Farrell

et al. adequately satisfies the limitations of claim 1. Farrell et al., however, do not

expressly show or suggest adjusting a process if the recent defect spatial signature

corresponds to at least one of the defect spatial signatures of the defect database.

39. Tobin et al. disclose a method for localizing and isolating an errant process

step by "integrating content based image retrieval, CBIR lan approach similar to Farrell

et al.), ... with a ... database of defect imagery and corresponding defect

characterization data (e.g. feature vectors such as those of Farrell et al.) to diagnose a

defective product and identify an errant process causing the defective product" (Tobin et

al. column 2, lines 13- 18). The method involves "providing to a content-based image

retrieval engine, a query image depicting a defect', retrieving from the database), a

selection of images, each image having image content similar to image content

extracted from the query image', and, ranking the selection of images according to a

similarity metric" (Tobin et al. column 2, lines 43-49). Moreover, Tobin et al. suggest

using this information (i.e. the similar corresponding) defect images) to "localize, isolate,

and correct (adjust) an errant manufacturing process step" (Tobin et al. column 1, lines

61-65), corresponding to the set of images similar (corresponding) to the query image.

In other words, adjusting a process if the recent defect spatial signature (i.e. defect

characterization data - Tobin et al. column 3, lines 4-12) corresponds to at least one of

the defect spatial signatures of the defect database.

40. The teachings of Tobin et al. and Farrell et al. are combinable because they

are analogous art. Specifically, both Tobin et al. and Farrell et al. use a CBIR approach

for the detection of defects in semiconductor products. Therefore, given the teachings of

Tobin et al., it would have been obvious to one of ordinary skill in the art, at the time of

the applicant's claimed invention to adjusting a process if the recent defect spatial

signature (the query feature vector of Farrell et al. or the defect characterization data of

Tobin et al.) corresponds to at least one of the defect spatial signatures of the defect

database. The motivation for doing so would have been to rectify errant processes that

detract from the yield of the manufactured products.

41. The following is in regard to Claim 1 1. As indicated above, process

anomalies correspond directly to defects and, therefore, defect spatial signatures. For

this reason, they are treated as being essentially the same. Given this, Claim 11 recites

essentially the same limitations as claim 7. Therefore, with regard to claims 11, remarks

analogous to those presented above relative to claim 7 are applicable.

42. The following is in regard to Claim 17. As indicated above, Farrell et al. derive

defect maps representing the defects of an observed wafer. The captured defect

images used in Tobin et al.'s method can loosely be regard as being defect maps, as well. Taking this into account, it should be evident that remarks analogous to those presented above relating to claim 7 also apply to claim 17.

43. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Farrell et al., in view of the Applicant's admitted prior ad, as disclosed in the Applicant's Background of Invention (pages 1-2 of the Applicant's disclosure). For the sake of brevity, the Applicant's admitted prior ad will be referred to simply as Prior Art, henceforth in this document.

44. The following is in regard to Claim 9. As shown above, the method of Farrell et al. adequately satisfies the limitations of claim 1. Farrell et al., however, do not expressly show or suggest that the defect spatial signatures are from at least one of particle contamination, mechanical surface damage, wafer-spinning processes, scratching, and polishing.

45. According to Prior Art (Prior Art, page 1, lines 18-20), "events capable of causing semiconductor wafer) defects include, but are not limited to, particle contamination, scratching, polishing anomalies, wafer spinning processes, watermarks, particle stains, and micro-scratching".

46. The teachings of Farrell et al. and Prior Art are combinable because they are analogous arty. Specifically, the teachings of both Farrell et al. and Prior Art are directed to methods that detect defects in semiconductor wafers, or the like, using image analysis in tandem with a defect database. Therefore, given that particle contamination, scratching, polishing anomalies, wafer-spinning processes, watermarks, particle stains, and micro-scratching are typical defects found during semiconductor wafer manufacturing, it would have been obvious to one of ordinary skill in the ad, at the time of the applicant's claimed invention, to accommodate defect spatial signatures (i.e. feature vectors) corresponding to (from) at least one of particle contamination, mechanical surface damage, wafer spinning processes, scratching, and polishing. The motivation for doing so would have been to detect defects corresponding to at least one of particle contamination, mechanical surface damage, wafer- spinning processes, scratching, and polishing.

Citation of Relevant Prior Art

47. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

(1)-(3) disclose methods and/or systems that detect wafer defects by comparison to defect records stored in a database of defect information.

(1) U.S. Patent 5,917,332. Chen et al. . Publication Date: June 1999.

(2) U.S. Patent 6,603,873. Gordon et al. Publication Date: August 2003

I3J U.S. Patent 5,913, 105. McIntyre et al. Publication Date: June 1999.

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Wes Tucker whose telephone number is (571) 272-

7427. The examiner can normally be reached on 9:00am - 5:30pm, Monday - Friday. If

attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Amelia Au can be reached on (571) 272-7427-6604. The fax phone number

for the organization where this application or proceeding is assigned is 703-872-9306.

Wes Tucker

5-30-05

AMELIA M. AU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600